North Carolina Department of Public Instruction
INSTRUCTIONAL SUPPORT TOOLS
FOR ACHIEVING NEW STANDARDS

6th Grade Mathematics ● Unpacked Content

For the new Common Core standards that will be effective in all North Carolina schools in the 2012-13.

This document is designed to help North Carolina educators teach the Common Core (Standard Course of Study). NCDPI staff are continually updating and improving these tools to better serve teachers.

What is the purpose of this document?
To increase student achievement by ensuring educators understand specifically what the new standards mean a student must know, understand and be able to do.

What is in the document?
Descriptions of what each standard means a student will know, understand and be able to do. The "unpacking" of the standards done in this document is an effort to answer a simple question "What does this standard mean that a student must know and be able to do?" and to ensure the description is helpful, specific and comprehensive for educators.

How do I send Feedback?
We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which the unpacking can be improved and made ever more useful. Please send feedback to us at feedback@dpi.state.nc.us and we will use your input to refine our unpacking of the standards. Thank You!

Just want the standards alone?
You can find the standards alone at www.corestandards.org .

Ratios and Proportional Relationships 6.RP

Common Core Cluster

Understand ratio concepts and use ratio reasoning to solve problems.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*	**6.RP.1** A ratio is the comparison of two quantities or measures. The comparison can be part-to-whole (ratio of guppies to all fish in an aquarium) or part-to-part (ratio of guppies to goldfish). Students need to understand each of these ratios when expressed in the following forms: $\frac{6}{15}$, 6 to 15 or 6:15. These values can be reduced to $\frac{2}{5}$, 2 to 5 or 2:5; however, students would need to understand how the reduced values relate to the original numbers.
6.RP.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b 0, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is ¾ cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."*[1] [1] Expectations for unit rates in this grade are limited to non-complex fractions.	**6.RP.2** A unit rate expresses a ratio as part-to-one. For example, if there are 2 cookies for 3 students, each student receives $\frac{2}{3}$ of a cookie, so the unit rate is $\frac{2}{3}$:1. If a car travels 240 miles in 4 hours, the car travels 60 miles per hour (60:1). Students understand the unit rate from various contextual situations.

6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.	**6.RP.3** Ratios and rates can be used in ratio tables and graphs to solve problems. Previously, students have used additive reasoning in tables to solve problems. To begin the shift to proportional reasoning, students need to begin using multiplicative reasoning. To aid in the development of proportional reasoning the cross-product algorithm is ***not*** expected at this level. When working with ratio tables and graphs, whole number measurements are the expectation for this standard. For example, At Books Unlimited, 3 paperback books cost \$18. What would 7 books cost? How many books could be purchased with \$54. To find the price of 1 book, divide \$18 by 3. One book is \$6. To find the price of 7 books, multiply \$6 (the cost of one book times 7 to get \$42. To find the number of books that can be purchased with \$54, multiply \$6 times 9 to get \$54 and then multiply 1 book times 9 to get 9 books. Students use ratios, unit rates and multiplicative reasoning to solve problems in various contexts, including measurement, prices, and geometry. Notice in the table below, a multiplicative relationship exists between the numbers both horizontally and vertically. (Red numbers indicate solutions.)

Number of Books	**Cost**
1	6
3	18
7	42
9	54

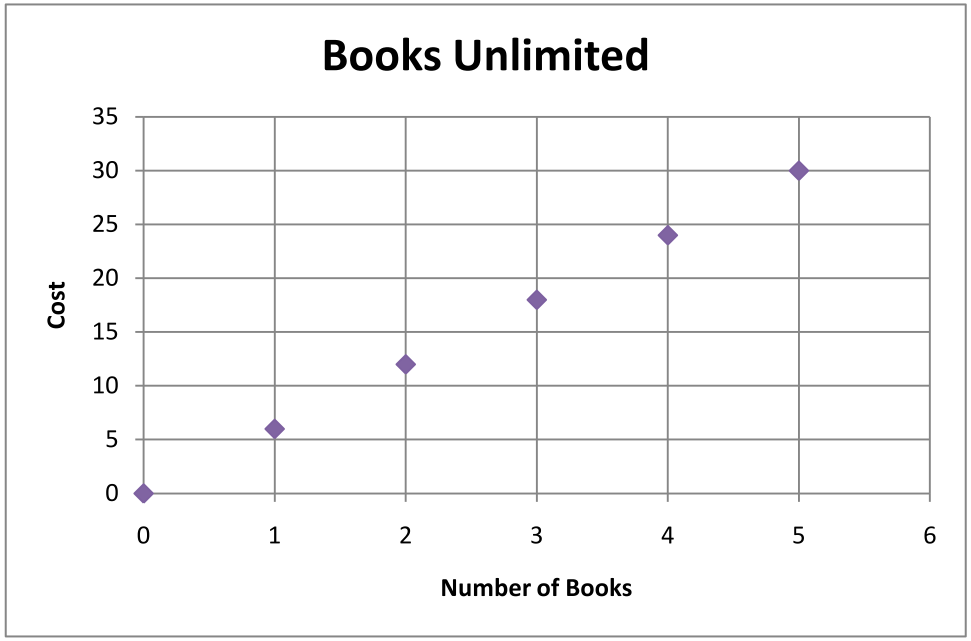
Students use tables to compare ratios. Another bookstore offers paperback books at the prices below. Which bookstore has the best buy? Explain how you determined your answer.

Number of Books	**Cost**
4	20
8	40

To help understand the multiplicative relationship between the number of books and cost, students write equations to express the cost of any number of books. Writing equations is foundational for work in 7th grade. For example, the equation for the first table would be $C = 6n$.

The numbers in the table can be expressed as ordered pairs (number of books, cost) and plotted on a coordinate

plane. Students are able to plot ratios as ordered pairs. For example, a graph of Books Unlimited would be:



b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*

Students recognize the use of ratios, unit rate and multiplication in solving problems, which could allow for the use of fractions and decimals.

The ratio tables above use unit rate by determining the cost of one book. However, ratio tables can be used to solve problems without the use of a unit rate. For example, in trail mix, the ratio of cups of peanuts to cups of chocolate candies is 3 to 2. How many cups of chocolate candies would be needed for 9 cups of peanuts.

Peanuts	Chocolate
3	2

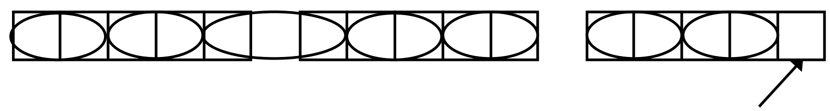
One possible way to solve this problem is to recognize that 3 cups of peanuts times 3 will give 9 cups. The amount of chocolate will also increase at the same rate (3 times) to give 6 cups of chocolate.

	Students could also find the number of cups of chocolate candies for 1 cup of peanuts by dividing both sides of the table by 3, giving $\frac{2}{3}$ cup of chocolate for each cup of peanuts. To find the amount of chocolate needed for 9 cups of peanuts, students multiply the unit rate by nine $(9 \bullet \frac{2}{3})$, giving 6 cups of chocolate.
c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.	This is the students' first introduction to percents. Percentages are a rate per 100. Models, such as percent bars or 10 x 10 grids should be used to model percents. Students use percentages to find the part when given the percent, by recognizing that the whole is being divided into 100 parts and then taking a part of them (the percent). For example, to find 40% of 30, students could use a 10 x 10 grid to represent the whole (or 30). If the 30 is divided into 100 parts, the rate for one block is 0.3. Forty percent would be 40 of the blocks, or 40 x 0.3, which equals 12. Student also find the whole, given a part and the percent. For example, if 25% of the students in Mrs. Rutherford's class like chocolate ice cream, then how many students are in Mrs. Rutherford's class if 6 like chocolate ice cream? Students can reason that if 25% is 6 and 100% is 4 times the 25%, then 6 times 4 would give 24 students in Mrs. Rutherford's class.
d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	A ratio can be used to compare measures of two different types, such as inches per foot, milliliters per liter and centimeters per inch. Students recognize that a conversion factor is a fraction equal to 1 since the quantity described in the numerator and denominator is the same. For example, $\frac{12 \text{ inches}}{1 \text{ foot}}$ is a conversion factor since the numerator and denominator name the same amount. Since the ratio is equivalent to 1, the identity property of multiplication allows an amount to be multiplied by the ratio. Also, the value of the ratio can also be expressed as $\frac{1 \text{ foot}}{12 \text{ inches}}$ allowing for the conversion ratios to be expressed in a format so that units will "cancel". Students use ratios as conversion factors and the identity property for multiplication to convert ratio units. For example, how many centimeters are in 7 feet, given that 1 inch = 2.54 cm. $7 \text{ feet} \text{ x } \frac{12 \text{ inches}}{1 \text{ foot}} \text{ x } \frac{2.54 \text{ cm}}{1 \text{ inch}} = 7 \cancel{\text{feet}} \text{ x } \frac{12 \cancel{\text{inches}}}{1 \cancel{\text{foot}}} \text{ x } \frac{2.54 \text{ cm}}{1 \cancel{\text{inch}}} = 7 \text{ x } 12 \text{ x } 2.54 \text{ cm} = 213.36 \text{ cm}$ **Note:** Conversion factors will be given. Conversions can occur both between and across the metric and English system. Estimates are not expected.

The Number System — 6.NS

Common Core Cluster

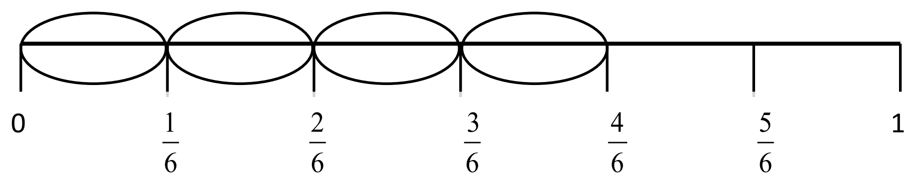
Apply and extend previous understands of multiplication and division to divide fractions by fractions.

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
6.NS.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?*	**6.NS.1** In 5th grade students divided whole numbers by unit fractions. Students continue this understanding by using visual models and equations to divide whole numbers by fractions and fractions by fractions to solve word problems. Students understand that a division problem such as $3 \div \frac{2}{5}$ is asking, "how many $\frac{2}{5}$ are in 3?" One possible visual model would begin with three whole and divide each into fifths. There are 7 groups of two-fifths in the three wholes. However, one-fifth remains. Since one-fifth is half of a two-fifths group, there is a remainder of $\frac{1}{2}$. Therefore, $3 \div \frac{2}{5} = 7\frac{1}{2}$, meaning there are $7\frac{1}{2}$ groups of two-fifths. Students interpret the solution, explaining how division by fifths can result in an answer with halves.  This section represents one-half of two-fifths Students also write contextual problems for fraction division problems. For example, the problem, $\frac{2}{3} \div \frac{1}{6}$ can be illustrated with the following word problem: Susan has $\frac{2}{3}$ of an hour left to make cards. It takes her about $\frac{1}{6}$ of an hour to make each card. About how many can she make?

This problem can be modeled using a number line.

1. Start with a number line divided into thirds.

2. The problem wants to know how many sixths are in two-thirds. Divide each third in half to create sixths.



3. Each circled part represents $\frac{1}{6}$. There are four sixths in two-thirds; therefore, Susan can make 4 cards.

The Number System 6.NS

Common Core Cluster

Compute fluently with multi-digit numbers and find common factors and multiples.

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
6.NS.2 Fluently divide multi-digit numbers using the standard algorithm.	**6.NS.2** Procedural fluency is defined by the Common Core as "skill in carrying out procedures flexibly, accurately, efficiently and appropriately". In the elementary grades, students were introduced to division through concrete models and various strategies to develop an understanding of this mathematical operation (limited to 4-digit numbers divided by 2-digit numbers). In 6^{th} grade, students become fluent in the use of the standard division algorithm. This understanding is foundational for work with fractions and decimals in 7^{th} grade.
6.NS.3 Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.	**6.NS.3** Procedural fluency is defined by the Common Core as "skill in carrying out procedures flexibly, accurately, efficiently and appropriately". In 4^{th} and 5^{th} grades, students added and subtracted decimals. Multiplication and division of decimals was introduced in 5^{th} grade (decimals to the hundredth place). At the elementary level, these operations were based on concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. In 6^{th} grade, students become fluent in the use of the standard algorithms of each of these operations.

The Number System 6.NS

Common Core Cluster

Compute fluently with multi-digit numbers and find common factors and multiples.

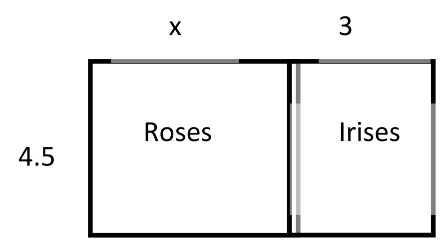
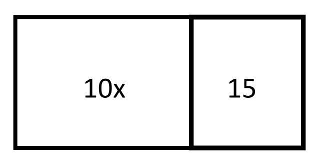
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.NS.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. For example, express 36 + 8 as 4 (9 + 2).	Students will find the greatest common factor of two whole numbers less than or equal to 100. For example, the greatest common factor of 40 and 16 can be found by 1) listing the factors of 40 (1, 2, 4, 5, 8, 10, 20, 40) and 16 (1, 2, 4, 8, 16), then taking the greatest common factor (8). Eight (8) is also the largest number such that the other factors are **relatively prime** (two numbers with no common factors other than one). For example, 8 would be multiplied by 5 to get 40; 8 would be multiplied by 2 to get 16. Since the 5 and 2 are relatively prime, then 8 is the greatest common factor. If students think 4 is the greatest, then show that 4 would be multiplied by 10 to get 40, while 16 would be 4 times 4. Since the 10 and 4 are not relatively prime (have 2 in common), the 4 cannot be the greatest common factor. 2) listing the prime factors of 40 (2 • 2 • 2 • 5) and 16 (2 • 2 • 2 • 2) and then multiplying the common factors (2 • 2 • 2 = 8). Students also understand that the greatest common factor of two prime numbers will be 1. Students use the greatest common factor and the distributive property to find the sum of two whole numbers. For example, 36 + 8 can be expressed as 4 (9 + 20 = 4 (11). Students find the least common multiple of two whole numbers less than or equal to twelve. For example, the least common multiple of 6 and 8 can be found by 1) listing the multiplies of 6 (6, 12, 18, 24, 30, …) and 8 (8, 26, 24, 32, 40…), then taking the least in common from the list (24); or 2) using the prime factorization. Step 1: find the prime factors of 6 and 8. 6 = 2 • 3 8 = 2 • 2 • 2 Step 2: Find the common factors between 6 and 8. In this example, the common factor is 2 Step 3: Multiply the common factors and any extra factors: 2 • 2 • 2 • 3 or 24 (one of the twos is in common; the other twos and the three are the extra factors.

The Number System	6.NS
Common Core Cluster	
Compute fluently with multi-digit numbers and find common factors and multiples.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.NS.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	**6.NS.5** Students use rational numbers (fractions, decimals, and integers) to represent real-world contexts and understand the meaning of 0 in each situation. For example, 25 feet below sea level can be represented as -25; 25 feet above sea level can be represented as +25. In this scenario, zero would represent sea level.
6.NS.6 Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., – (–3) = 3, and that 0 is its own opposite	**6.NS.6** In elementary school, students worked with positive fractions, decimals and whole numbers on the number line. In 6th grade, students extend the number line to represent all rational numbers and recognize that number lines may be either horizontal or vertical (ie. thermometer). Students recognize that a number and its opposite are equidistance from zero (reflections about the zero). The opposite sign (–) shifts the number to the opposite side of 0. For example, – 4 could be read as "the opposite of 4" which would be negative 4. The following example, – (–6.4) would be read as "the opposite of the opposite of 6.4" which would be 6.4. Zero is its own opposite.

b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.	Students worked with Quadrant I in elementary school. As the *x*-axis and *y*-axis are extending to include negatives, students begin to with the Cartesian Coordinate system. Students recognize the point where the *x*-axis and *y*-axis intersect as the origin. Students identify the four quadrants and are able to identify the quadrant for an ordered pair based on the signs of the coordinates. For example, students recognize that in Quadrant II, the signs of all ordered pairs would be (–, +). Students understand the relationship between two ordered pairs differing only by signs as reflections across one or both axes. For example, in the ordered pairs (-2, 4) and (-2, -4), the *y*-coordinates differ only by signs, which represents a reflection across the *x*-axis. A change is the *x*-coordinates from (-2, 4) to (2, 4), represents a reflection across the *y*-axis. When the signs of both coordinates change, [(2, -4) changes to (-2, 4)], the ordered pair has been reflected across both axes.
c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.	Students are able to plot all rational numbers on a number line (either vertical or horizontal) or identify the values of given points on a number line. For example, students are able to identify where the following numbers would be on a number line: $-4.5, 2, 3.2, -3\frac{3}{5}, 0.2, -2, \frac{11}{2}$.
6.NS.7 Understand ordering and absolute value of rational numbers. a. Interpret statements of inequality as statements about the relative position of two numbers on a number line. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.*	**6.NS.7** Students identify the absolute value of a number as the distance from zero but understand that although the value of -7 is less than -3, the absolute value (distance) of -7 is greater than the absolute value (distance) of -3. Students use inequalities to express the relationship between two rational numbers, understanding that the value of numbers is smaller moving to the left on a number line. For example, –4 ½ < –2 because –4 ½ is located to the left of –2 on the number line.
b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3°C > –7°C to express the fact that –3°C is warmer than –7°C.*	Students write statements using < or > to compare rational number in context. However, explanations should reference the context rather than "less than" or "greater than". For example, the balance in Sue's checkbook was –12.55. The balance in John's checkbook was –10.45. Since –12.55 < –10.45, Sue owes more than John. The interpretation could also be "John owes less than Sue".

c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.*	Students understand absolute value as the distance from zero and recognize the symbols | | as representing absolute value. For example, | –7 | can be interpreted as the distance –7 is from 0 which would be 7. Likewise | 7 | can be interpreted as the distance 7 is from 0 which would also be 7. In real-world contexts, the absolute value can be used to describe size or magnitude. For example, for an ocean depth of –900 feet, write | –900| = 900 to describe the distance below sea level.
d. Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.*	When working with positive numbers, the absolute value (distance from zero) of the number and the value of the number is the same; therefore, ordering is not problematic. However, negative numbers have a distinction that students need to understand. As the negative number increases (moves to the left on a number line), the value of the number decreases. For example, –24 is less than –14 because –24 is located to the left of –14 on the number line. However, absolute value is the distance from zero. In terms of absolute value (or distance) the absolute value of –24 is greater than –14. For negative numbers, as the absolute value increases, the value of the number decreases.
6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.	**6.NS.8** Students find the distance between points whose ordered pairs have the same x-coordinate (vertical) or same y-coordinate (horizontal). For example, the distance between (–5, 2) and (–9, 2) would be 4 units. This would be a horizontal line since the *y*-coordinates are the same. In this scenario, both coordinates are in the same quadrant. The distance can be found by using a number line to find the distance between –5 and –9. Students could also recognize that –5 is 5 units from 0 (absolute value) and that –9 is 9 units from 0 (absolute value). Since both of these are in the same quadrant, the distance can be found by finding the difference between 9 and 5. (| 9 | - | 5 |). Coordinates could also be in two quadrants. For example, the distance between (3, –5) and (3, 7) would be 12 units. This would be a vertical line since the *x*-coordinates are the same. The distance can be found by using a number line to count from –5 to 7 or by recognizing that the distance (absolute value) from –5 to 0 is 5 units and the distance (absolute value) from 0 to 7 is 7 units so the total distance would be 5 + 7 or 12 units.

Expressions and Equations	6.EE
Common Core Cluster	
Apply and extend previous understanding of arithmetic to algebraic expressions.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.EE.1 Write and evaluate numerical expressions involving whole-number exponents.	**6.EE.1** Students demonstrate the meaning of exponents to write and evaluate numerical expressions with whole number exponents. The base can be a whole number, positive decimal or a positive fraction (ie. $\frac{1}{2}^5$ can be written $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}$ which has the same value as $\frac{1}{32}$). Students recognize that an expression with a variable represents the same mathematics (ie. x^5 can be written as $x \cdot x \cdot x \cdot x \cdot x$) and write algebraic expressions from verbal expressions.
6.EE.2 Write, read, and evaluate expressions in which letters stand for numbers. a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y.	**6.EE.2** Students write expressions from verbal descriptions using letters and numbers. Students understand order is important in writing subtraction and division problems. Students understand that the expression "5 times any number, *n*" could be represented with 5*n* and that a number and letter written together means to multiply.
b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.	Students use appropriate mathematical language to write verbal expressions from algebraic expressions. Students can describe expressions such as 3 (2 + 6) as the product of two factors: 3 and (2 + 6). The quantity (2 + 6) is viewed as one factor consisting of two terms.

c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole- number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas* $V = s^3$ *and* $A = 6\ s^2$ *to find the volume and surface area of a cube with sides of length s = ½.*	Students evaluate algebraic expressions, using order of operations as needed. Given an expression such as $3x + 2\ y$, find the value of the expression when *x* is equal to 4 and *y* is equal to 2.4. This problem requires students to understand that multiplication is understood when numbers and variables are written together and to use the order of operations to evaluate. 3 • 4 + 2 • 2.4 12 + 4.8 16.8 Given a context and the formula arising from the context, students could write an expression and then evaluate for any number. For example, it costs $100 to rent the skating rink plus $5 per person. The cost for any number (*n*) of people could be found by the expression, 100 + 5*n*. What is the cost for 25 people?.
6.EE.3 Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.*	**6.EE.3** Students use the distributive property to write equivalent expressions. For example, area models from elementary can be used to illustrate the distributive property with variables. Given that the width is 4.5 units and the length can be represented by x + 2, the area of the flowers below can be expressed as 4.5(*x* + 3) or 4.5*x* + 13.5.  When given an expression representing area, students need to find the factors. For example, the expression 10x + 15 can represent the area of the figure below. Students find the greatest common factor (5) to represent the width and then use the distributive property to find the length (2x + 3). The factors (dimensions) of this figure would be 5(2x + 3). 

6.EE.4 Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*	**6.EE.4** Students demonstrate an understanding of like terms as quantities being added or subtracted with the same variables and exponents. For example, $3x + 4x$ are like terms and can be combined as $7x$; however, $3x + 4x^2$ are not. This concept can be illustrated by substituting in a value for *x*. For example, $9x – 3x = 6x$ not 6. Choosing a value for *x*, such as 2, can prove non-equivalence. 9(2) – 3(2) = 6(2) however 9(2) – 3(2) ? 6 18 – 6 = 12 18– 6 ? 6 12 = 12 12 ≠ 6

Expressions and Equations	6.EE
Common Core Cluster	
Reason about and solve one-variable equations and inequalities.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.EE.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.	**6.EE.5** Students identify values from a specified set that will make an equation true. For example, given the expression $x + 2\frac{1}{2}$, which of the following value(s) for x would make $x + 2\frac{1}{2} = 6$. $\{0, 3\frac{1}{2}, 4\}$ By using substitution, students identify $3\frac{1}{2}$ as the value that will make both sides of the equation equal. The solving of inequalities is limited to choosing values from a specified set that would make the inequality true. For example, find the value(s) of x that will make $x + 3.5 \geq 9$. $\{5, 5.5, 6, \frac{15}{2}, 10.2, 15\}$ Using substitution, students identify 5.5, 6, $\frac{15}{2}$, 10.2, and 15 as the values that make the inequality true. NOTE: If the inequality had been $x + 3.5 > 9$, then 5.5 would not work since 9 is not greater than 9. This standard is foundational to **6.EE.7** and **6.EE.8**
6.EE.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	**6.EE.6**. Students write expressions to represent various real-world situations. For example, the expression $a + 3$ could represent Susan's age in three years, when a represents her present age. The expression $2n$ represents the number of wheels on any number of bicycles. Other contexts could include age (Johnny's age in 3 years if a represents his current age) and money (value of any number of quarters) Given a contextual situation, students define variables and write an expression to represent the situation. For example, the skating rink charges \$100 to reserve the place and then \$5 per person. Write an expression to represent the cost for any number of people. N = the number of people

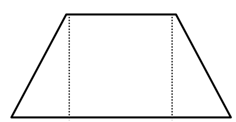
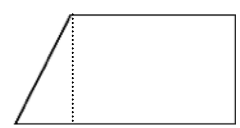
	100 + 5*n*
6.EE.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which *p*, *q* and *x* are all nonnegative rational numbers. **6.EE.8** Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.	**6.EE.7** Students have used algebraic expressions to generate answers given values for the variable. This understanding is now expanded to equations where the value of the variable is unknown but the outcome is known. For example, in the expression, $x + 4$, any value can be substituted for the *x* to generate a numerical answer; however, in the equation $x + 4 = 6$, there is only one value that can be used to get a 6. Problems should be in context when possible and use only one variable. Students write equations from real-world problems and then use inverse operations to solve one-step equations. Equations may include fractions and decimals with non-negative solutions. **6.EE.8** Many real-world situations are represented by inequalities. Students write an inequality and represent solutions on a number line for various contextual situations. For example, the class must raise at least \$80 to go on the field trip. If *m* represents money, then the inequality $m \geq$ to \$80. Students recognize that possible values can include too many decimal values to name. Therefore, the values are represented on a number line by shading.  A number line diagram is drawn with an open circle when an inequality contains a < or > symbol to show solutions that are less than or greater than the number but not equal to the number. The circle is shaded, as in the example above, when the number is to be included. Students recognize that possible values can include fractions and decimals, which are represented on the number line by shading. Shading is extended through the arrow on a number line to show that an inequality has an infinite number of solutions.

Expressions and Equations	6.EE
Common Core Cluster	
Represent and analyze quantitative relationships between dependent and independent variables.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.*	**6.EE.9** The purpose of this standard is for students to understand the relationship between two variables, which begins with the distinction between dependent and independent variables. The independent variable is the variable that can be changed; the dependent variable is the variable that is affected by the change in the independent variable. Students recognize that the independent variable is graphed on the x-axis; the dependent variable is graphed on the y-axis. Students recognize that not all data should be graphed with a line. Data that is discrete would be graphed with coordinates only. Discrete data is data that would not be represented with fractional parts such as people, tents, records, etc. For example, a graph illustrating the cost per person would be graphed with points since part of a person would not be considered. A line is drawn when both variables could be represented with fractional parts. Students are expected to recognize and explain the impact on the dependent variable when the independent variable changes (As the *x* variable increases, how does the *y* variable change?) Relationships should be proportional with the line passing through the origin. Additionally, students should be able to write an equation from a word problem and understand how the coefficient of the dependent variable is related to the graph and /or a table of values.

Geometry 6.G

Common Core Cluster

Solve real-world and mathematical problems involving area, surface area, and volume.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.G.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.	**6.G.1** Students continue to understand that area is the number of squares needed to cover a plane figure. Finding the area of triangles is introduced in relationship to the area of rectangles – a rectangle can be decomposed into two congruent triangles. Therefore, the area of the triangle is ½ the area of the rectangle. The area of a rectangle can be found by multiplying base x height; therefore, the area of the triangle is ½ bh or (b x h)/2. Students decompose shapes into rectangles and triangles to determine the area. For example, a trapezoid can be decomposed into triangles and rectangles (see figure below). Using the trapezoid's dimensions, the area of the individual triangle(s) and rectangle can be found and then added together.  Isosceles trapezoid  Right trapezoid Students should know the formulas for rectangles and triangles. "Knowing the formula" does not mean memorization of the formula. To "know" means to have an understanding of ***why*** the formula works and how the formula relates to the measure (area) and the figure. This understanding should be for *all* students.
6.G.2 Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge	**6.G.2** Previously students calculated the volume of right rectangular prisms (boxes) using whole number edges. The unit cube was 1 x 1 x 1. In 6^{th} grade the unit cube will have fractional edge lengths. (ie. ½ • ½ • ½) Students find the volume of the right rectangular prism with these unit cubes. For example, the right rectangular prism below has edges of 1¼", 1" and 1½". The volume can be found by recognizing that the unit cube would be ¼" on

lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	all edges, changing the dimensions to $\frac{5}{4}$", $\frac{4}{4}$" and $\frac{6}{4}$". The volume is the number of unit cubes making up the prism (5 x 4 x 6), which is 120 unit cubes each with a volume of $\frac{1}{64}$ (¼" x ¼" x ¼"). This can also be expressed as $\frac{5}{4} \times \frac{6}{4} \times \frac{4}{4}$ or $\frac{120}{64}$. "Know the formula" does not mean memorization of the formula. To "know" means to have an understanding of ***why*** the formula works and how the formula relates to the measure (volume) and the figure. This understanding should be for *all* students.
6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. **6.G.4** Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	**6.G.3** Students are given the coordinates of polygons to draw in the coordinate plane. If both *x*-coordinates are the same (2, -1) and (2, 4), then students recognize that a vertical line has been created and the distance between these coordinates is the distance between -1 and 4, or 5. If both the *y*-coordinates are the same (-5, 4) and (2, 4), then students recognize that a horizontal line has been created and the distance between these coordinates is the distance between -5 and 2, or 7. Using this understanding, student solve real-world and mathematical problems, including finding the area of quadrilaterals and triangles. This standard can be taught in conjunction with **6.G.1** to help students develop the formula for the triangle by using the squares of the coordinate grid. Given a triangle, students can make the corresponding square or rectangle and realize the triangle is ½. Students progress from counting the squares to making a rectangle and recognizing the triangle as ½ to the development of the formula for the area of a triangle. **6.G.4** A net is a two-dimensional representation of a three-dimensional figure. Students represent three-dimensional figures whose nets are composed of rectangles and triangles. Students recognize that parallel lines on a net are congruent. Using the dimensions of the individual faces, students calculate the area of each rectangle and/or triangle and add these sums together to find the surface area of the figure.

Statistics and Probability	**6.SP**
Common Core Cluster	
Develop understanding of statistical variability.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.SP.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.*	**6.SP.1** Students differentiate between statistical questions and those that are not. A statistical question is one that collects information that addresses differences in a population. The question is framed so that the responses will allow for the differences. For example, the question, "How tall am I?" is not a statistical question because there is only one response; however, the question, "How tall are the students in my class?" is a statistical question since the responses would allow for differences.
6.SP.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.	**6.SP.2** The distribution is the arrangement of the values of a data set. Distribution can be described using center (median or mean), and spread. Data collected can be represented on graphs, which will show the shape of the distribution of the data. Students examine the distribution of a data set and discuss the center, spread and overall shape with dot plots, histograms and box plots.

6.SP.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.	**6.SP.3** Data sets contain many numerical values that can be summarized by one number such as a measure of center. The measure of center gives a numerical value to represent the center of the data (ie. midpoint of an ordered list or the balancing point). Another characteristic of a data set is the variability (or spread) of the values. Measures of variation are used to describe this characteristic.

Statistics and Probability 6.SP

Common Core Cluster

Summarize and describe distributions.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
6.SP.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.	**6.SP.4** Students display data set using number lines. Dot plots, histograms and box plots are three graphs to be used. A dot plot is a graph that uses a point (dot) for each piece of data. The plot can be used with data sets that include fractions and decimals. A histogram shows the distribution of continuous data using intervals on the number line. The height of each bar represents the number of data values in that interval. A box plot shows the distribution of values in a data set by dividing the set into quartiles. The box plot is constructed from the five-number summary (minimum, lower quartile, median, upper quartile, and maximum). These values give a summary of the shape of a distribution. Students understand that the size of the box or whiskers represent the

6.SP.5 Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.	**6.SP.5** Students record the number of observations. Using histograms, students determine the number of values between specified intervals. Given a box plot and the total number of data values, students identify the number of data points that are represented by the box. Reporting of the number of observations must consider the attribute of the data sets, including units (when applicable). Consideration may need to be given to how the data was collected (ie. random sampling) Given a set of data values, students summarize the measure of center with the median or mean. The median is the value in the middle of a ordered list of data. This value means that 50% of the data is greater than or equal to it and that 50% of the data is less than or equal to it. The mean is the arithmetic average or balance point of a distribution. The mean is the sum of the values in a data set divided by how many values there are in the data set. The mean represents the value if all pieces of the data set had the same value. As a balancing point, the mean is the value where the data values above and the data values below have the same value. Measures of variation can be described using the interquartile range or the Mean Absolute Deviation. The interquartile range describes the variability between the middle 50% of a data set. It is found by subtracting the lower quartile from the upper quartile. It represents the length of the box in a box plot and is not affected by outliers. The Mean Absolute Deviation describes the variability of the data set by determining the absolute value deviation (the distance) of each data piece from the mean and then finding the average of these deviations. Both the interquartile range and the Mean Absolute Deviation are represented by a single numerical value. Higher values represent a greater variability in the data. Students understand how the measures of center and measures of variability are represented by the graphical display. Students describe the context of the data, using the shape of the data and are able to use this information to determine an appropriate measure of center and measure of variability.